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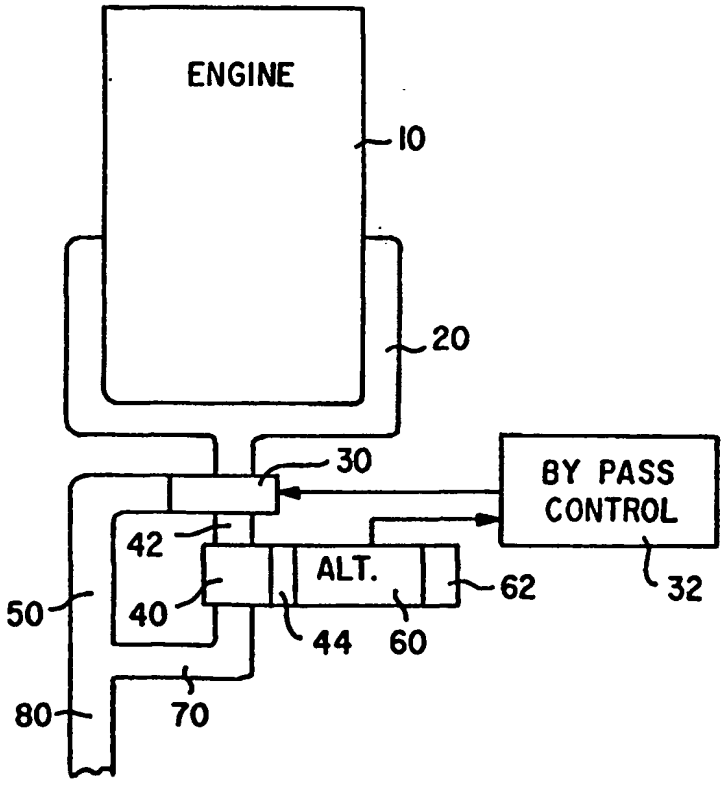
(54) Title: EXHAUST-DRIVEN TURBINE-POWERED ALTERNATOR

(57) Abstract

The exhaust gas from an engine can be used to generate electrical power for a vehicle. On demand, the exhaust gas can power a turbine which in turn will drive an alternator to generate electricity for the vehicle's loads.



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EXHAUST-DRIVEN TURBINE-POWERED ALTERNATOR

Background of the Invention

In conventional automobiles and trucks, accessories are driven by a series of belts connected to the flywheel of the engine. Such accessories include the alternator, the water pump, the air conditioning compressor, the power steering pump, and the secondary air pump. These loads present a significant drain on the engine. An alternative means of powering these devices would decrease the load on the engine and improve its performance.

Brief Description of Drawings

The invention will be more fully understood and further advantages will become apparent when reference is made to the following detailed description of the invention and the accompanying drawings in which:

Figure 1 is a schematic diagram of an exhaust gas-driven electrical vehicle power system; and

Figures 2-4 are schematic diagrams of alternative exhaust gas-driven electrical vehicle power systems.

Description of the Invention

The exhaust gas from a vehicle's engine can be used to provide electrical power to a load. The exhaust gas drives one or more turbines positioned in the exhaust line which in turn drives an alternator. A controlled bypass gate and passage flanking the turbine can selectively pass a desired portion of the exhaust gas through the turbine while the balance passes around the turbine.

An automotive exhaust system having an exhaust gas-powered electrical system in shown in Figure 1. The system is powered by the exhaust gas which leaves the engine 10 through an exhaust manifold 20. In this figure, the exhaust system is of the single-pipe exhaust variety, but it could also be a dual pipe system or some other configuration. The engine 10 can b an internal combustion

device or some other engine that produces an exhaust gas that will drive a turbine.

The manifold 20 is connected to a bypass gate valve 30 that can channel the exhaust gas from the manifold 20 through a turbine input manifold 42 to a turbine 40 and a turbine bypass 50. It should be understood that anywhere from zero to 100% of the exhaust gas can be directed by the bypass gate valve through the turbine 40. Powered by the exhaust gas, the turbine 40 drives an alternator 60 and the exhaust gas exits the turbine 40 through a turbine exhaust 70. The turbine exhaust 70 and the exhaust bypass 50 are both connected to an exhaust pipe 80 leading perhaps to a muffler (not shown). The turbine 40 can be sized to maximize its output over the desired operating range of the engine.

The bypass gate valve 30 could be controlled by a bypass controller 32 responsive to the speed of the alternator 60 and perhaps the load conditions. The speed can be measured as a function of the alternator shaft speed or the alternator output voltage, as will readily occur to those skilled in the art. Further, if the turbine speed is too high to properly run the alternator 60, a gear reduction unit 44 could be inserted between the turbine 40 and the alternator 60.

In most applications, the desired output would be direct current. Therefore, a rectifier 62 would rectify the output of the alternator 60. The output of the rectifier 62 in turn could provide power to a variety of loads commonly found in an automobile such as a water pump, radiator fan, air conditioner compressor, and a power steering pump. Instead of a conventional belt drive off the crankshaft, each of these devices could be driven by an electric motor receiving power from the alternator 60.

If there is sufficient power output from the alternator 60, electric heaters could be provided for the passenger compartment in lieu of water-based heat exchangers commonly employed. Electric heaters would

reduce the size of the heater system and provide relatively instantaneous heat, eliminating the wait for the engine to warm up. Such heaters could be placed in more than one location to provide zone control and uniform heating.

A variation of the system of Figure 1 is illustrated in Figure 2. This alternative system employs two turbines, each handling a different speed range. An engine 100 produces exhaust gas that exits through an exhaust manifold 120 and enters a three-way bypass gate valve 130. The bypass gate valve 130 directs the exhaust gas to a first turbine 140, a second turbine 150, or a turbine bypass 160.

The first turbine 140 has a turbine input manifold 142, a turbine shaft 144, and a turbine exhaust 146; similarly, the second turbine 150 has a turbine input manifold 152, a turbine shaft 154, and a turbine exhaust 156. The two turbine shafts 144 and 154 drive an alternator 170. Finally, the turbine bypass 160 and the two turbine exhausts 146 and 156 are all connected to an exhaust pipe 180. A rectifier is not shown but could readily be used with this arrangement.

Depending the engine speed and the load, the bypass gate valve 130 can be set to direct the exhaust gas to one turbine or the other, as appropriate. A bypass gate valve control 190, responsive to the alternator speed and perhaps the load conditions can be provided to control bypass gate valve 130.

If desired, multiple turbines, each sized to a different exhaust gas flow and speed, could be employed to provide drive throughout the range of engine speeds. Alternatively, the turbines could be identical in size and the bypass gate valve 130 could selectively channel exhaust gas to one or more turbines to achieve the desired output.

In some configurations, the exhaust gas flow at low engine speeds (e.g., at start up) may not provide sufficient pow r t the turbine to turn the alternator (or alternators). As illustrated in Figure 3, the engine 300 powers a mechanical driv , such as a belt-driven magnetic

clutch 320 connected to the alternator 330, which also has a turbine drive 340. The engine 300 has an exhaust manifold 302 connected to a bypass gate valve 310 that can channel the exhaust gas from the manifold 302 to the turbine drive 340. When the exhaust gas flow is sufficient, the magnetic clutch 320 will disengage, and a bypass control 312 will direct the bypass gate 310 to direct the exhaust gas through the turbine drive 340 to turn the shaft of the alternator 330.

The arrangement of Figure 1 can be modified for use in a hybrid vehicle. Such a vehicle might be alternately powered by a relatively small internal combustion engine and an electric motor running on batteries. If the engine were programmed to run at a single speed (or within a narrow speed range), the bypass gate valve 30 and the turbine bypass 50 of Figure 1 could be eliminated, as shown in Figure 4. The turbine 40 could be optimized for the gas flow at the single speed to develop maximum torque. The resultant output of the rectifier 62 would be supplied to the batteries 400.

While there has been described what is believed to be the preferred embodiment of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such embodiments that fall within the true scope of the invention.

What is claimed is:

1. An apparatus for generating electricity for an electrical load, the apparatus being powered by exhaust gas passing out of an exhaust line of an engine, comprising:

at least one turbine positioned in the exhaust line and powered by the exhaust gas, the turbine having an output shaft;

an alternator for generating alternating current electricity mechanically linked to the output shaft of the turbine;

a bypass gate and passage flanking the turbine, for selectively, variably passing at least a portion of the exhaust gas around the turbine; and

a control module, responsive to the electrical load and the pressure of the exhaust gas, for controlling the bypass gate.

2. An apparatus as set forth in claim 1, further comprising a plurality of turbines positioned in the exhaust line and individually and selectively powered by the exhaust gas.

3. An apparatus as set forth in claim 1, further comprising selectively-enabled means directly powered by the engine for mechanically driving the alternator.

4. A vehicular electric generating system for providing electrical power to a load, for a vehicle having an internal combustion engine that produces exhaust gas that passes out through an exhaust line, comprising:

at least one turbine positioned in the exhaust line and powered by the exhaust gas, the turbine having an output shaft;

an alternator for generating alternating current electricity mechanically linked to the output shaft of the turbine;

a bypass gate and passage flanking the turbine, for selectively, variably passing at least a portion of the exhaust gas around the turbine; and

a control module, responsive to the electrical load and the pressure of the exhaust gas, for controlling the bypass gate.

5. A vehicular electric generating system as set forth in claim 4, further comprising a plurality of turbines positioned in the exhaust line and individually and selectively powered by the exhaust gas.

6. A vehicular electric generating system as set forth in claim 4, further comprising selectively-enabled means directly powered by the engine for mechanically driving the alternator.

7. A vehicular electric generating system for providing electrical power to a load, for a vehicle having an engine that operates within a narrow speed range and produces exhaust gas that passes out through an exhaust line, comprising:

at least one turbine positioned in the exhaust line and powered by the exhaust gas, the turbine having an output shaft; and

an alternator for generating alternating current electricity mechanically linked to the output shaft of the turbine.

8. A method for generating electricity and providing electrical power to a load in a vehicle having an engine that produces exhaust gas that passes out through an exhaust line, at least one turbine positioned in the exhaust line, and an alternator for generating alternating current electricity mechanically linked to the output shaft of the turbine, comprising the steps of:

powering the turbine with the exhaust gas to turn the turbine and the output shaft;

turning the alternator to generate electricity; and

in response to the load and the pressure of the exhaust gas, regulating the quantity of exhaust gas impinging on the turbine.

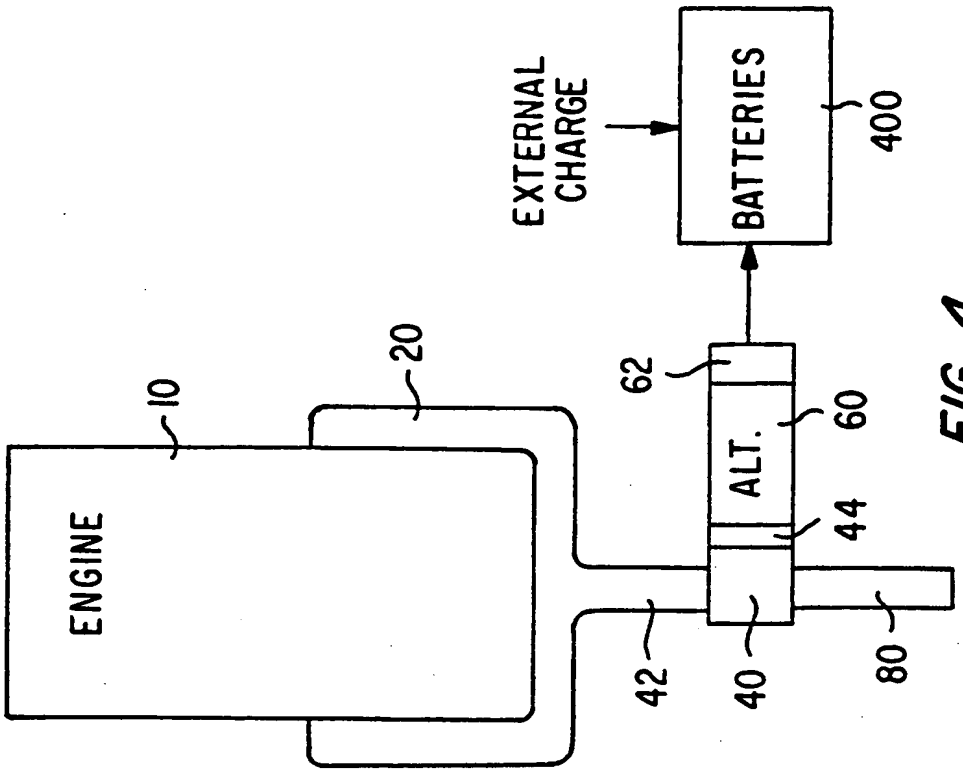

FIG. 4

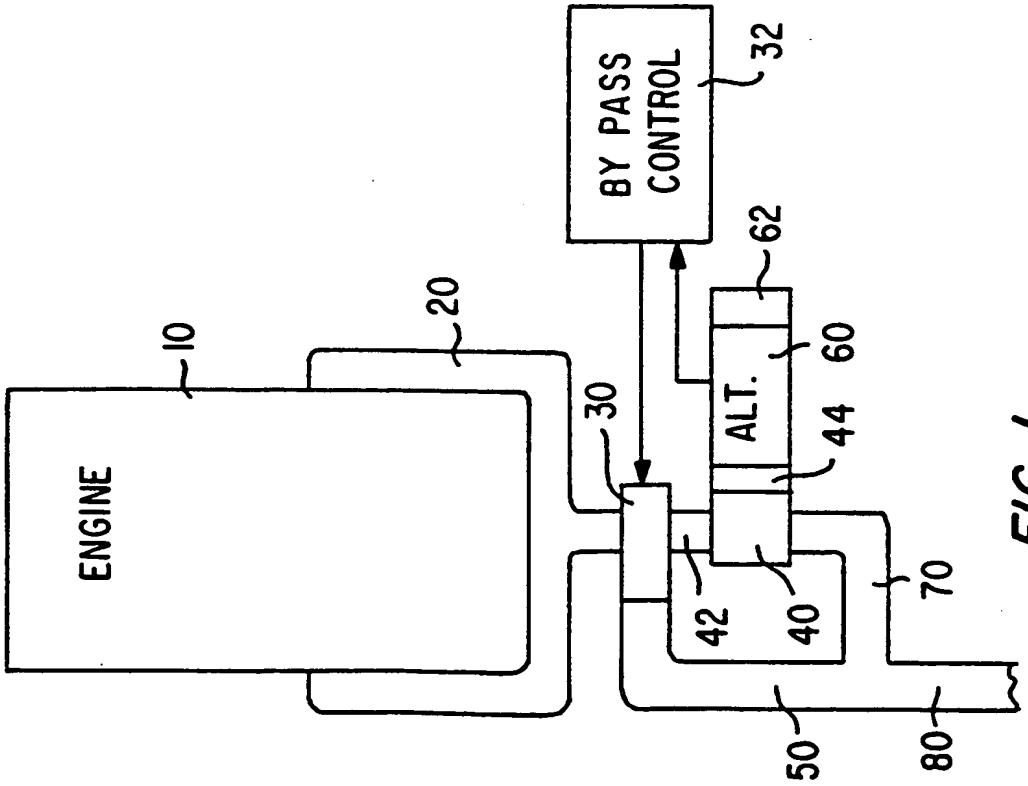

FIG. 1

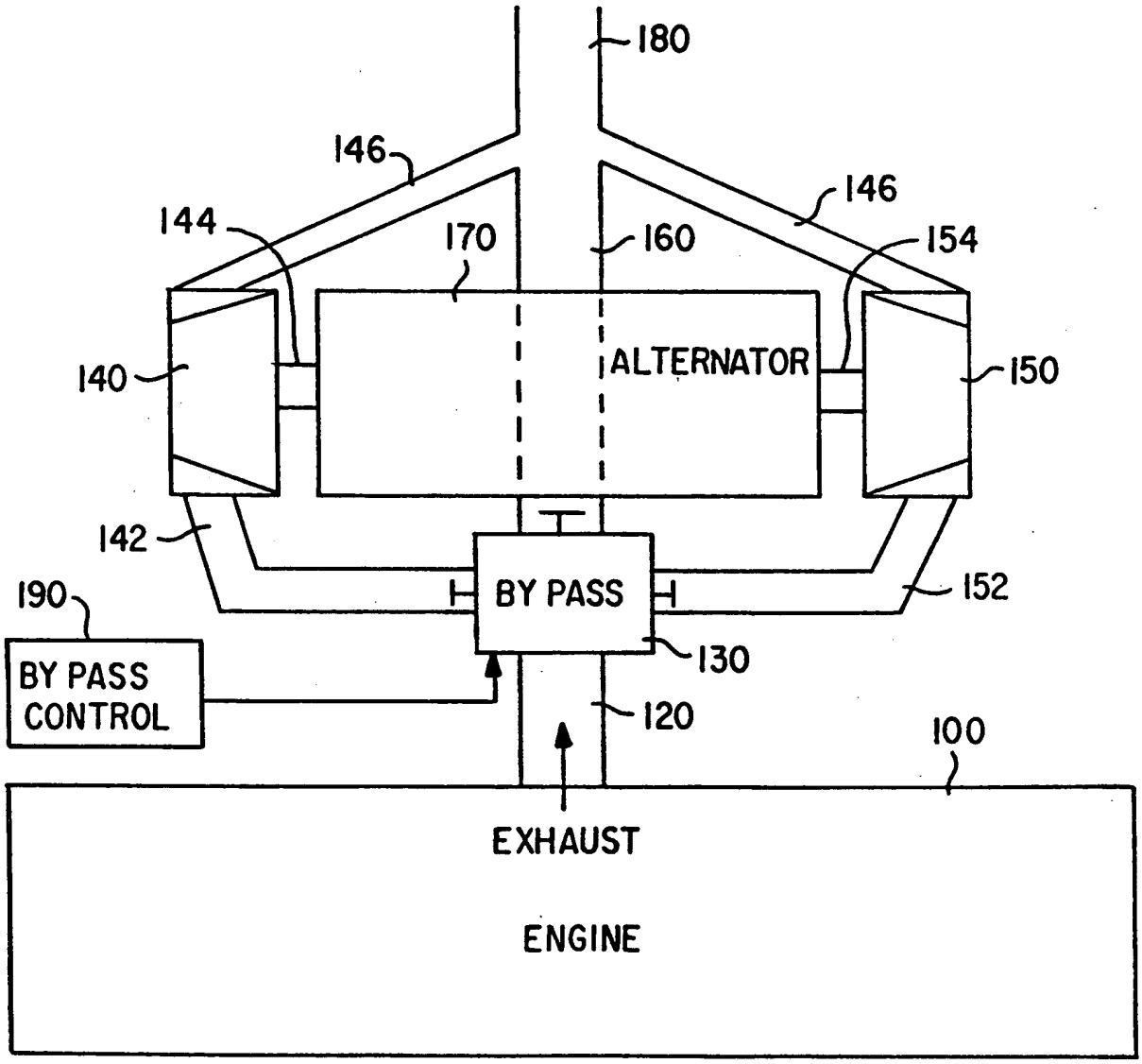
180
146
146
144
170
160
154
140
ALTERNATOR
150
142
190
BY PASS
152
BY PASS CONTROL
130
120
100
EXHAUST
ENGINE

FIG. 2

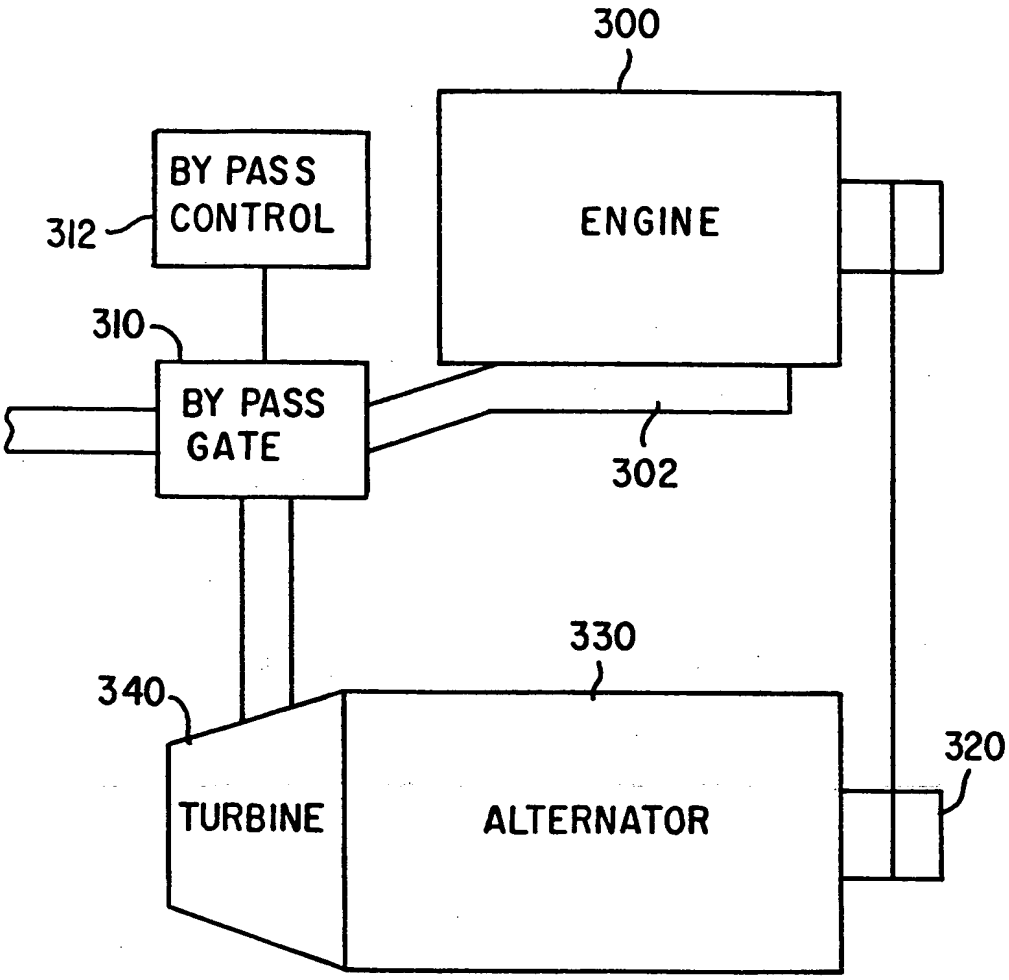

FIG. 3

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 98/04410

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F02B63/04 F02B37/00 F02B37/10

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 120 (M-300), 6 June 1984 & JP 59 026375 A (KENJI OKUJIMA), 10 February 1984,	1,3,4,6
A	see abstract	7,8

X	EP 0 141 634 A (ISUZU MOTORS LTD) 15 May 1985 see figure 1 see abstract	1
A	see page 12, line 10 - page 13, line 17	2,4,5,7, 8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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